Patent Claims

1. An apparatus for three-dimensional object recording having at least two imaging systems, which have imaging optics facing the object, with at least one being in the form of an observation system for object observation, and at least one of them having an elementary means which moves in front of the imaging optics and whose elementary image is moved on an image point line through the object area, characterized in that the elementary means are in the form of elementary means which move with a lateral component with respect to the optical axis of the imaging optics, and the observation system is arranged for observation along the image point line.

2. The apparatus as claimed in the ~~preceding claim~~ claim 1, characterized in that two imaging systems represent both observation systems.

3. The apparatus as claimed in the ~~preceding claim~~ Claim 2, characterized in that the observation systems comprise detection arrays, in particular CCD arrays.

4. The apparatus as claimed in the ~~preceding claim~~ Claim 3, characterized in that the detector arrays are moved synchronously.

5. The apparatus as claimed in the ~~preceding claim~~ Claim 4, characterized in that the detector arrays are arranged on piezo control means, in particular for synchronous movement with a distance change.

6. The apparatus as claimed in the ~~preceding claim~~ claim 5, characterized in that an evaluation unit is provided which, for signal evaluation, is connected to the two detector arrays and, for evaluation of the signal response, is arranged to signal an object surface point recording when a predetermined signal response is detected on one array region of the first imaging system,

and a predetermined signal response is likewise recorded on an associated array region of the second imaging system.

7. The apparatus as claimed in one of the ~~preceding claims,~~ Claim 1 characterized in that one of the imaging systems is an illumination system.

8. The apparatus as claimed in the ~~preceding claim,~~ Claim 7 characterized in that, in order to illuminate the object, the illumination system comprises a large number of lighting emitting elements, which provide the moving elementary means.

9. The apparatus as claimed in one of the ~~preceding claims,~~ Claim 1 characterized in that a light emitting means exciter circuit is provided in order to at least partially simulate the elementary means movement as a virtual movement by successive [lacuna] a predetermined excitation pattern of the light emitting elements.

10. The apparatus as claimed in ~~one of the preceding claims,~~ Claim 1 characterized in that the illumination system comprises a moving grating, in particular a geometric shadow grating.

11. The apparatus as claimed in ~~one of claims 7 to 10,~~ Claim 7 characterized in that the observation system comprises a large number of observation elements.

12. The apparatus as claimed in ~~the preceding claim,~~ Claim 11 characterized in that the observation elements are provided by regions, in particular elements of a detector array, in particular of a CCD array.

13. The apparatus as claimed in ~~the preceding claim,~~ Claim 12 characterized in that the detector output has an associated evaluation unit, which is designed to signal a surface recording when a specific signal pattern, in particular a signal maximum and in particular an absolute signal maximum, is recorded, on one observation element in the array.

Claim 13

14. The apparatus as claimed in ~~the preceding claim~~, characterized in that the evaluation unit is designed to determine the coordinates of the recorded object surface region as a function of the position of the moving elementary means.

claim 1

15. The apparatus as claimed in ~~one of the preceding claims~~, characterized in that the pupil of the observation system is arranged at least approximately in the focal plane of the imaging optics of the illumination system.

16. A method for 3D recording of an object surface in a scene using an electromagnetic radiation source, with this radiation source being formed at least by means of a structured array as a structured-light-emitting array, and illuminating a surface element, and having an illumination beam path with an illumination objective which is associated with the structured-light-emitting array and produces an image of the light-emitting surface element, and having an imaging beam path for the imaging of elements of the object surface and a receiver array having at least two elements, and having an imaging objective which is associated with the receiver array, and elements of the receiver array detect radiation from elements of the illuminating object surface in the object area during the recording process and images in the object area are also always formed with a geometric-optical sharp-image volume of elements of the receiver array by means of the imaging objective, and, by means of the imaging of the light-emitting surface element with the illumination objective, an image thereof is formed in the object area with a geometric-optical sharp-image volume, and the detection of radiation from the elements of the object surface is carried out by means of elements of the receiver array in a time period (Δt_B) in which a predetermined shift is carried out with at least one

light-emitting surface element of the structured-light-emitting array, including a predetermined optical movement as a result of a geometric-optical path length change, in order in this way for an light-emitting surface element to emit radiation at different times and different points, characterized in that the sharp-image volume of an image of the light-emitting surface element is formed in the object area, and the sharp-image volume of an image of the receiver array in the object area and an element of the object surface are made to at least approximately coincide by means of a predetermined movement of the light-emitting surface element with a movement component parallel to the optical axis of the illuminating objective, and with that element of the receiver array which is involved in this coincident experiencing a radiation which varies with time when the coincident occurs.

17. The method for 3D recording of at least one object surface in at least one scene as claimed in claim 16, characterized in that, in the time intervals (Δt_i), of the detection of radiation, the light-emitting surface elements are each moved on their own movement path relative to the illumination objective, and the light-emitting surface elements each have an at least approximately predetermined constant relative light intensity during light intensity distribution, at least at a time (t_i) within a time interval (Δt_i), and the light-emitting surface elements are in this case always positioned on a respective B-path (BS_{Aj}) with the B-paths (BS_{Aj}) representing the nominal locations of the light-emitting surface elements at least at a time (t_i) within the time interval (Δt_i), and the images of these B-paths (BS_{Aj}) in the object area always being formed by imaging

by means of an illumination objective (1) to form a path locus (SB_1) with a converge point (K_1), with the convergence point (K_1), being positioned in the object area at least at a distance from the optical axis of the illumination objective (1) of the 16th part, and at a maximum distance of 16 times the distance of the pupil center (PZ_{OB}) of the illumination objective (1) from the pupil center (PZ_{OA}) of the imaging objective (2), and, at least in a time period (Δt_B) during the movement process of the light-emitting surface elements, in each case one, and only one, image of a receiver element and in each case one, and only one, image of a light-emitting surface element are positioned at least approximately jointly on the image of the B-path (BS_{Aj}) in the object area, at least at a single time (t_i) within each time interval (Δt_i) for the detection, and thus, at least at this time (t_i), a pair with a fixed association in each case being formed in the object area from the image of a receiver element and the image of a light-emitting surface element, and such pairs thus being produced in the object area, and these pairs being shifted through the object area, with sharp-image volumes of images of the light-emitting surface elements coinciding with surface elements of the object surface (5) at least once in the movement process within a time interval (Δt_i), and the elements of the receiver array detecting a signal profile with at least one relative extreme of the signal magnitude in the time interval (Δt_i) of the coincident, with the time period (Δt_B) being made to be greater than the time interval (Δt_i), and at least one time interval (Δt_i) thus being matched in time in the time period (Δt_B), and, during the movement process, the positions of the light-emitting surface elements of the structured-light-

emitting array and the positions of the elements of the receiver array always being determined from the position of the illumination objective (1) and from the position of the imaging objective (2) in the 3D recording arrangement and the focal length(f_B) of the illumination objective (1) and the focal length (f_A) of the imaging objective (2), and being provided such that both the light-emitting surface elements of the structured-light-emitting array and the elements of the receiver array being imaged in the same plane in the object area, at least approximately in one part of the object area.

18. The method for 3D recording of at least one object surface (5) in at least one scene as claimed in ~~at least one of claims 16 and 17,~~ claim 16 characterized in that, in the time intervals (Δt_i) of the detection of radiation, a light-emitting surface element is in each case positioned on each B-path, and the B-paths are directed at the pupil center of the imaging objective in the array area, so that the convergence point is in this case position at least approximately at the pupil center of the imaging objective and, during the movement process, in each case one image of a receiver element and in each case one image of a light-emitting surface element are positioned at least approximately jointly on the image of a B-path in the object area, and a pair with a fixed association is in each case formed in the object area from the image of a receiver element and the image of a light-emitting surface element, and pairs of images are thus produced in the object area and, during the movement process of the light-emitting surface element, in each case one image of a receiver element and in each case one image of a light-emitting surface element are made to coincide at least approximately once in the object area.

19. The method for 3D recording of at least one object

surface (5) in at least one scene as claimed in ~~at least one of claims 16 and 17~~ claim 16 characterized in that the convergence point (K_i) is positioned at least approximately in the focal plane of the illumination objective (1) in the object area and, additionally, at the pupil center (PZ_{OA}) of the pupil of an imaging objective (2) in the object area, and, during the movement process, in each case one image of a receiver element and in each case one image of a light-emitting surface element (3A) are positioned at least approximately jointly on the image of a B-path (BS_{Aj}) in the object area, at least at a time (t_i) within each time interval (Δt_i) for detection, and thus, at least at this time (t_i), a pair with a fixed association is in each case formed in the object area from the image of a receiver element and from the image of a light-emitting surface element (3A) and such pairs with a fixed association are thus produced in the object area and the B-paths (BS_{aj}) are positioned parallel to a straight line (g_{AP}), with the straight line (g_{AP}) intersecting the focal point F_{AB} of the illumination objective (1) in the array area, and having the gradient whose magnitude is the quotient of the "distance between the pupil center (PZ_{OA}) of the pupil of the imaging objective (2) in the object area from the axis of the illumination objective (1) and the focal length (f_B) of the illumination objective (1)", with this gradient of the straight line (g_{AP}) being related to the axis of the illumination objective (1).

20. The method for 3D recording of at least one object surface (5) in at least one scene as claimed in ~~one of claims 16, 17 and 19,~~ claim 16 characterized in that an at least approximately straight-line relative movement of the receiver array with respect to the imaging objective (2) is carried out parallel to the optical axis of the

imaging objective (2), and, during the movement, signal values are read successively from each receiver element a number of times, with a signal profile being formed in this way by means of one receiver element in each case and, when a number of movement paths of elements of the receiver array produced in this way are imaged using the imaging objective (2), at least one path locus (SB_2), with a convergence point (K_2) at the focal point (F_{OA}) of the imaging objective (2) is at least approximately formed from their images in the object area.

21. The method for 3D recording of at least one object surface (5) in at least one scene as claimed in ~~at least one of claims 16, 17, 19 and 20,~~ claim 16 characterized in that the convergence point (K_1) of the path locus (SB_1) is made to coincide at least approximately, together with the convergence point (K_2) of the path locus (SB_2) in the object area, both with the focal point (F_{OA}) and with the pupil center (PZ_{OA}) of the pupil of the imaging objective (2), with the illumination objective (1) and the imaging objective (2) each being designed to be at least approximately telecentric on the array side, and light-emitting surface elements (3A) being moved on paths at least approximately parallel to a straight line (g_A), and the straight line (g_A) passes through the focal point (F_{AB}) of the illumination objective (1) in the array area, and the gradient of the straight line (g_A) being provided by the magnitude of the quotient "focal length of the illumination objective (1) and the distance (d) of the focal point (F_{AA}) of the imaging objective (2) from the axis of the illumination objective (1) in the object area", with this gradient of the straight line (g_A) being related to a straight line at right angles to the axis of the illumination objective (1).

22. The method for 3D recording of at least one object

surface (5) in at least one scene as claimed in ~~at least one of claims 16 to 21,~~ claim 16 characterized in that the position of at least one light-emitting surface element is made to be fixed in space, and at least components of the illumination objective are moved.

23. The method for 3D recording of at least one objective surface in at least one scene having at least one electromagnetic radiation source, with this force being formed by means of at least one structured array as at least one structured-light-emitting array having at least two surface elements, and illuminating at least one surface element, with each light-emitting surface element being defined by an at least approximately predetermined light intensity and by a predetermined location, and having at least one illumination beam path with at least one illumination objective, which is associated with the structured-light-emitting array and produces an image of the light-emitting surface element, and having at least one imaging beam path for imaging of elements of the at least one object surface, and having at least one receiver array with at least two elements and an imaging objective, which is associated with the receiver array, and elements of the receiver array in the recording process [lacuna] detect radiation from elements of the at least one illuminated object surface in the object space, and images in the object area, which corresponds to the scene space, are always formed with a geometric optical sharp-image volume by elements of the receiver array by means of the imaging objective, and elements of the at least one object surface are imaged by means of at least one imaging objective, and an image of a light-emitting surface element is formed in the object area with a geometric-optical sharp-image volume by means of the imaging of the at least one light-imaging surface element

by means of the illumination objective, characterized in that light-emitting surface elements are each arranged at least approximately at their own location in the structured-light-emitting array relative to the illumination objective in the time intervals (Δt_i) for detection of radiation in a time period (Δt_B), and are caused to emit light by actuation and are imaged by the illumination objective, and the at least one light-emitting surface element is always imaged at a predetermined location in the object area, at least at a time (t_i) within the time interval (Δt_i), and this image location of the at least one light-emitting surface element in the object area is varied by actuation in that a respective different, predetermined surface element is actuated and is caused to emit light, so that the image of each light-emitting surface element is shifted through the object area on a controllable path curve, structured from distance increments of the images of the distances between the light-emitting surface elements in the array area - in the sense of predetermined, different positions being assumed in a controlled manner - and at least one signal value being detected using a receiver element in each position after the movement through an integer multiple of the distance increment, and a signal profile thus being formed from a number of processes of detection and reading of elements of the receiver array, and the location of the detected and read element in the receiver array being varied continuously, and the locations of the detected and read elements in the receiver array lying at locations in the receiver array, and the image of this location being at least approximately optically conjugated with the predetermined image location of the light-emitting surface element in the object area, and in

each case one image of a detected and read element in the receiver array thus being made to coincide in the object area with the image of in each case one light-emitting surface element, at least at a time (t_i) within the time interval (Δt_i), and a pair of images with alternating images thus being produced in each case, and these pairs gradually assuming different positions in the object area, and such pairs thus gradually passing through the object area in depth, with sharp-image volumes of the image of each light-emitting surface element coinciding with each surface element of the object area at least once in the time period (Δt_B) in a time interval (Δt_B), and the detected and read elements in the receiver array having a signal profile with at least one relative extreme of the signal magnitude in the time interval (Δt_i) of coincident, with the time period (Δt_B) being made to be greater than the time interval (Δt_i), and at least one time interval (Δt_i) thus being made to match the time period (Δt_B) in time.

24. The method for 3D recording with at least one object surface (5) in at least one scene having a first and at least one second imaging beam path, with a line of symmetry being formed between the two axes of two imaging objectives (2, 33) for imaging of the object surfaces (5, 18, 19), and having in each case at least one receiver array which is associated with the imaging objective in each imaging beam path, with the two receiver arrays each having elements which detect radiation from the elements of the illuminated object surfaces in object space during the time period (Δt_B) in the recording process, characterized in that, in the time period (Δt_B) in the recording process, the two receiver arrays are each moved to a different location, and the detection of radiation

from the elements of the object surfaces by means of the elements in the receiver array is carried out at least approximately at the same time, and the elements in the receiver array are then read and signal values are in each case obtained, and, during the recording process, the two receiver arrays are moved on movement paths at the same time and the images of the movement paths in the object area are positioned at least approximately on the line of symmetry between the two axes of the objectives (2, 33) and a convergence point (K_{21}) is formed from the path locus of the images of the movement paths of the individual elements in the first receiver array, and a convergence point (K_{22}) is formed from the path locus of the images of the movement paths of the individual elements in the second receiver array, and the convergence point (K_{21}) and the convergence point (K_{22}) are made to coincide at least approximately on the line of symmetry and form a convergence point (K_0), and the two receiver arrays are moved such that their images at least partially coincide in the object area, so that the images of the elements in the first receiver array and the images of the elements in the second receiver array are at least approximately made to coincide in pairs in the object area, with those elements in the two receiver arrays which form pairs each representing corresponding elements, and signal profiles (S_1) for the first receiver array being formed by reading the elements during the movement of the first receiver array, and the first receiver array being moved parallel to a straight line (g_{A1P}) and the elements in the first receiver array thus being moved at least approximately parallel to a straight line (g_{A1P}), and signal profiles (S_2) of the second receiver array being formed by reading the elements during the movement of the second receiver array, and the

movement of the second receiver array being carried out parallel to a straight line (g_{A2P}) and the elements in the second receiver array thus being moved at least approximately parallel to a straight line (g_{A2P}), and the straight line (g_{A1P}) (at least approximately at a point (P_{A1}) on the line of symmetry in the main plane of the first imaging objective (2) in the array area) and the straight line (g_{A2P}) (at least approximately at a point (P_{A2}) on the line of symmetry in the main plane of the second imaging objective (33)) being made to intersect, with the straight line (g_{A1P}) additionally including the focal point (F_{A1}) of the first imaging objective (33), and the straight line (g_{A2P}) including the focal point (F_{A2}) of the imaging objective (2) in the array area, and with in each case one signal piece ($S_{1\ part\ position\ kj}$) and ($S_{2\ part\ position\ kj}$) being formed from the two signal profiles (S_{1j}) and (S_{2j}) of two corresponding elements and of the receiver arrays, which are stored in the memory of a computer over the path of the movement of the two receiver arrays, by means of the synchronous movement of a window function, with this window function having at least a single window with a minimum window length corresponding to two signal values and having a maximum window length which corresponds at least approximately to the length of the signal profiles (S_{1j}) and (S_{2j}), by at least one signal value which corresponds to an increment in the movement of the receiver arrays, over each of these two signal profiles (S_{1j}) and (S_{2j}) and from each window at that time at the position k, where $1 \leq k \leq m$, in each case one signal piece ($S_{1\ part\ position\ kj}$) and ($S_{2\ part\ position\ k\ j}$) is formed, with these successively formed signal pieces ($S_{1\ part\ j\ position\ k\ j}$) and ($S_{2\ part\ j\ position\ k\ j}$) being superimposed in one subregion in each of the two signal profiles (S_{1j}) and (S_{2j}), and with the movement of

the window function in the two signal pieces in each case being started at the same end of the two signal profiles (S_{1j}) and (S_{2j}) and the crosscorrelation function in each case being calculated on the basis of two signal pieces at the position 1 ($S_{1\ \text{part position}\ 1\ j}$) and ($S_{2\ \text{part position}\ 1\ j}$), but with one of the two signal pieces being inverted in advance, that is to say all the values thereof are mirrored, and the maximum of the crosscorrelation function ($MCC_{1\ 2\ j\ \text{position}\ 1}$) between 0 and 1 thus being calculated from an original signal piece ($S_{1\ \text{part position}\ 1\ j}$) and from an inverted signal piece ($S_{2\ \text{part position}\ 1\ \text{INV}\ j}$), and being stored, and then, once the window function has been moved to the position 2, the maximum of the crosscorrelation function ($MCC_{1\ 2\ j\ \text{position}\ 2}$) is calculated in the described way for the next two signal pieces until the window function arrives at the position m at the other end of the two signal profiles (S_{1j}, S_{2j}) and the maximum ($MCC_{1\ 2\ j\ \text{position}\ m}$) of the crosscorrelation function ($MCC_{1\ 2\ j\ \text{position}\ m}$) is once again established and a maximum value curve is formed from m calculated maxima (MCC_m) with the maximum ($M_{m\ j}$) in this maximum value curve once again being determined and the location of the maximum ($M_{m\ j}$) on the maximum value curve being associated with the two original signal profiles and hence with the path of the movement with the two receiver arrays and, if a window function with only one window is used, the location of the maximum ($M_{1\ j}$) of the calculated crosscorrelation function ($MCC_{1\ 2\ j\ \text{position}\ 1}$) is associated in only one position with the two original signal profiles and hence with the path of the movement of the two receiver arrays, and the location of the respective maximum (M_{j}) determined in this way is defined as the location of that the image, associated with the two corresponding elements, of the respective elements of the

object surface (5, 18, 5) in the array area, and the z_o-coordinate of the respective element of the object surface is calculated from the location of this maximum (M_j) in the array area, and the x_o and y_o positions of the respective elements of an object surface (5, 18, 5) are also calculated from the known geometry of the 3D recording arrangement, and the positions of the elements of an object surface (5, 18, 19) with which signal profiles can be associated are thus calculated, with the geometry of the 3D recording arrangement being known, and the movement of the receiver arrays being determined.

25. The method for 3D recording of at least one object surface (5) in at least one scene as claimed in claim 24, characterized in that the axis of a first imaging objective (2) for imaging of the object surfaces (5, 18, 19) is aligned parallel to the axis of a second imaging objective (33) for imaging of the object surfaces (5, 18, 19), and the imaging objectives (2, 33) are made to be at least approximately physically identical, the main plane of the first imaging objective (33) in the array area and the main plane of the second imaging objective (2) coincide at least approximately in a common plane, the receiver arrays are located at least approximately jointly in one plane, and the two points P_{A1} and P_{A2} are made to coincide at least approximately at a point P_A.

26. The method for 3D recording of at least one object surface (5), which is illuminated by means of a radiation source (15), in at least one scene having a first and at least one second imaging beam path, with the axis of a first imaging objective (2) in the imaging beam path for imaging the object surfaces (5, 18, 19) being aligned parallel to the axis of a second imaging objective (33) in the imaging beam path for imaging of the object surfaces (5, 18, 19), and a line of symmetry thus being

formed between the two axes of the two imaging objectives (2, 33), and in each case having at least one receiver array associated with the imaging objective in each imaging beam path, and the two receiver arrays each having elements which detect electromagnetic radiation from the elements of the illuminated object surfaces in the object area in the time period (Δt_B) during the recording process, characterized in that the two receiver arrays each experience an electronically controlled, mechanical movement to a different location during the time period (Δt_B) in the recording process, and the detection of electromagnetic radiation from the elements of the object surfaces is carried out at least approximately at the same time by the elements of the receiver array for the duration of a time interval (Δt_i) and the elements of the receiver array are then read and signal values are in each case obtained and, during the recording process, the two receiver arrays are moved at the same time and parallel to the respective optical axes of the parallel imaging beam paths, which are at least approximately physically identical, and whose main planes coincide, with the object surfaces in the scene being illuminated, and the signal profile (S_{1z}) being formed by reading elements which are located laterally alongside one another in the first receiver array during the movement of the first receiver array in the direction of the optical axes such that the only elements of the receiver array which are in each case used for signal formation are those which lie on paths which are aligned parallel to a straight line (g_{A1P}) and at least approximately intersect the point (P_A) in the common main plane of the imaging objectives (2, 33), and the signal profile that is formed thus corresponds at least

approximately to the signal profile (S_1) produced during an actual movement parallel to a straight line (g_{A1P}) and a present coincident point is thus in each case formed at least at a time t_i in a time interval Δt_i, which coincident point is in each case formed successively in the time period Δt_B at different predetermined locations in the object area, and the signal profile (S_{2z}) is formed by reading elements which are located laterally alongside one another in the second receiver array during the movement of the second receiver array in the direction of the optical axes, such that the only elements in the receiver array which are in each case used for signal formation are those which lie on paths which are aligned parallel to a straight line (g_{A2P}) and which at least approximately intersects the point (P_A) in the common main plane of the imaging objectives (2, 33), and the signal profile which is formed thus corresponds at least approximately to the signal profile (S_2) corresponding to this during an actual movement parallel to a straight line (g_{A2P}), and the straight line (g_{A1P}) and the straight line (g_{A2P}) are made to intersect at a point (P_A) and, in addition, the straight line (g_{A1P}) includes the focal point (F_{A1}) of the first imaging objective (33) while the straight line(g_{A2P}) includes the focal point (F_{A2}) of the imaging objective (2) in the array area, and from the two signal profiles (S_{z1j}) and (S_{z2j}) of two alternating corresponding elements and of the receiver arrays, which correspond only at a time t_i with the signal profiles (S_{z1j}) and (S_{z2j}) being stored in the memory of a computer over the path of the movement of the two receiver arrays, and the evaluation in this case being carried out using the correlation method with two windowed signal profiles, with the signal pieces in each case being inverted in places.

27. The method for 3D recording of at least one object surface (5), which is illuminated by means of a radiation source (4), in at least one scene as claimed in ~~at least one of claims 25 and 26,~~ Claim 25 characterized in that at least one imaging objective is moved with respect to the receiver array.

28. An arrangement for 3D recording of at least one object surface (5) in at least one scene by means of at least one radiation source (4), with this being formed by means of at least one structured array as at least one structured-light-emitting array, and at least one light-emitting surface element being formed by means of at least one illuminating beam path with at least one illumination objective (1) which is associated with the structured-light-emitting array, including an image thereof, and has an effective aperture stop with an aperture center, for structured illumination of the object surfaces (5) in the object area, and having at least one imaging beam path, which is associated with the illumination beam path, with at least one imaging stage for the at least one object surface (5) having at least one imaging objective (2, 33), which is associated with the receiver array or an image thereof, for imaging of the elements of the object surfaces, which has an effective aperture stop with an aperture center, with elements of the at least one receiver array detecting radiation from the elements of the illuminated object surfaces in the object area during the recording process, and with the pupil center (PZ_{OB}) of the illumination objective (1) in the object area being at a distance (d) from the pupil center (PZ_{OA}) of the imaging objective (2) in the object area, characterized in that the structured-light-emitting array has an associated movement system with at least one moving component, and the movement

paths of the light-emitting surface elements in the array area are formed at least from the mechanical movement of the structured-light-emitting array, and, after imaging of these movement paths by means of the illumination objective (1) in the object area, their image is formed at least approximately as at least one path locus (SB_1) with a convergence point (K_1), and the convergence point (K_1) is at a minimum distance from the axis of the illumination objective (1) of the 16th part of the distance (d), and is at a maximum distance from the axis of the illumination objective (1) of 16 times the distance (d).

29. The arrangement for 3D recording of at least one object surface (5) in at least one scene as claimed in claim 28, characterized in that the movement paths of the light-emitting surface elements are arranged at least approximately parallel in the array area, and the convergence point (K_1) is thus positioned at least approximately in the focal plane of the illumination objective (1) in the object area, and at the pupil center (PZ_{OA}) of the imaging objective (2) in the object area.

30. The arrangement for 3D recording of at least one object surface (5) in at least one scene as claimed in ~~at least one of claims 28 and 29,~~ claim 28 characterized in that the light-emitting array is in the form of an electronically controllable line grating in which the position of the lines is controllable.

31. The arrangement for 3D recording of at least one object surface (5) in at least one scene as claimed in claim 30, characterized in that the lines are arranged at right angles to the main section, and the movement paths of the light-emitting surface elements, and hence also of the light-emitting surface elements, are formed with local extremes of the light intensity in the array area as a

result of the mechanical movement of the structured-light-emitting array and of the electronic control of the structured-light-emitting array in the array area, and at least one path locus with a convergence point (K_1) is formed at least approximately from these movements paths in the array area, and the convergence point (K_1) is arranged at the pupil center (PZ_{AA}) of imaging objective (2) in the array area.

32. The arrangement for 3D recording of at least one object surface (5) in at least one scene as claimed in ~~at least one of claims 28 to 31,~~ Claim 28 characterized in that the movement paths of the light-emitting surface elements are arranged at least approximately parallel to a defined straight line (g_{AP}), and the straight line (g_{AP}) intersects the focal point (F_{AB}) of the illumination objective (1) in the array area, and having the gradient whose magnitude is the quotient of the "distance between the pupil center (PZ_{OA}) of the pupil of the imaging objective (2) in the object area from the axis of the illumination objective (1) and the focal length (f_B) of the illumination objective (1)", with this gradient of the straight line (g_{AP}) being related to the axis of the illumination objective (1).

33. The arrangement for 3D recording of at least one object surface (5) in at least one scene as claimed in ~~at least one of claims 28 to 32,~~ Claim 28 characterized in that one component of the movement system is associated with the receiver array and hence movement paths (AS_{Aj}) on parallel straight lines are associated during the mechanical movement of the receiver array on a movement path of its elements, with at least one path locus (SB_2) with a convergence point (K_2) in the object area being formed at least approximately from the images (AS_{oj}) of the paths (AS_{Aj}) for imaging by the imaging objective (2), and the

convergence point (K_1) and the convergence point (K_2) being made to coincide at least approximately in the object area with the focal point (F_{OA}) and the pupil center (PZ_{OA}) of the pupil of the imaging objective (2), and the imaging objective (2) being designed to be telecentric on the side of the area of the array.

34. The arrangement for 3D recording of at least one object surface (5) in at least one scene as claimed in ~~at least one of claims 28 to 33,~~ claim 28 characterized in that one component of the movement system is associated with the receiver array and hence movement paths (AS_{Aj}) on parallel straight lines are associated during the mechanical movement of the receiver array on a movement path of its elements, with at least one path locus (SB_2) with a convergence point (K_2) in the object area being formed at least approximately from the images of these paths for imaging by the imaging objective (2), and the convergence point (K_1) and the convergence point (K_2) being made to coincide at least approximately in the object area with the focal point (F_{OA}) and the pupil center (PZ_{OA}) of the pupil of the imaging objective (2), and the illumination objective (1) and the imaging objective (2) each being designed to be telecentric on the side of the area of the arrays, and the axes of the illumination objective (1) and of the imaging objective (2) being arranged parallel to one another, and their focal planes being made to coincide in the object area, and in that the components of the movement system are arranged such that the light-emitting array is provided with an overall movement direction at least approximately parallel to a straight line (g_A) in the array area, such that the elements of the structured-light-emitting array move on straight lines which are parallel to the straight line (g_A), and this straight line (g_A) is made to intersect the focal

point (F_{AB}) of the illumination objective (1) in the array area, and the gradient of the straight line (g_A) being provided by the magnitude of the quotient "focal length (F_B) of the illumination objective (1) and the distance (d) of the focal point (F_{AA}) of the imaging objective (2) in the object area from the axis of the illumination objective (1)", with this gradient of the straight line (g_A) being related to a straight line at right angles to the axis of the illumination objective (1).

35. The arrangement for 3D recording of at least one object surface (5) in at least one scene as claimed in ~~at least one of claims 28 to 34,~~ claim 28 characterized in that the structured array is formed at least on one partial region of a disk (83), which has an associated rotating precision bearing with a shaft having a rotating motor, so that a rotating disk (83) is formed.

36. The arrangement for 3D recording of at least one object surface (5) in at least one scene as claimed in claim 35, characterized in that the rotating disk (83) has transparent plate sectors of different geometric-optical thickness.

37. The arrangement for 3D recording of at least one object surface (5) in at least one scene as claimed in ~~at least one of claims 28 to 36,~~ claim 28 characterized in that the receiver array is a color camera.

38. The arrangement for 3D recording of at least one object surface (5) in at least one scene as claimed in ~~at least one of claims 28 to 37,~~ claim 28 characterized in that a special receiver array is used having RGB channels, and this array has an associated fourth channel, an NIR channel, for obtaining information for the 3D point cloud.

39. The arrangement for 3D recording of at least one object surface (5) in at least one scene by at least one radiation source (4), with this source being formed by

means of at least one structured array as at least one structured-light-emitting array with at least two surface elements, and at least one light-emitting surface element being formed, and having at least one illumination beam path with at least one illumination objective (1), which is associated with the structured-light-emitting array and has an effective aperture stop with an extent and an aperture center, for structured illumination of the object surfaces (5) in the object area, and having at least one imaging beam path, which is associated with the illumination beam path, for the object surfaces (5) with at least one imaging objective (2), which is associated with the receiver array or an image thereof, for imaging of the elements of the object surfaces (5), and which has an effective aperture stop, with elements of the at least one receiver array detecting radiation from the elements of the illuminated object surfaces in the object area during the recording process, and with the pupil center (PZ_{OB}) of the illumination objective (1) being at a distance from the pupil center (PZ_{OA}) of the imaging objective (2), with the distance being at least one eighth of the extent of the aperture stop of the illumination objective (1), and with light-emitting surface elements having an at least approximately predetermined light intensity with a light intensity distribution such that at least one image of a light-emitting surface element is formed in the object area by the imaging using the illumination objective (1), characterized in that, in the object area, the sharp-image volume of at least one image of a light-emitting surface element in a structured-light-emitting array - by virtue of the predetermined geometric-optical association between the light-emitting surface element and the illumination objective, and the geometric-optical

association between the elements in the receiver array and the imaging objective, and the geometric association between the illumination objective and the imaging objective -is permanently matched to the sharp-image volume which is represented by the images of the elements of the receiver array in the object area.

40. The arrangement for 3D recording of at least one object surface (5) in at least one scene as claimed in claim 39, characterized in that the sharp-image volume which is produced by the images of the elements of the receiver array in the beam propagation direction has at least one depth extent which is as large as the sharp-image volume of an individual image of a light-emitting surface element and, in the object area, an image of at least one light-emitting surface element of a structured array is in each case associated in a fixed manner with an image of an element in the receiver array.

41. The arrangement for 3D recording of at least one object surface (5) in at least one scene as claimed in ~~at least one of claims 39~~ claim 39 and 40, characterized in that the structured array is formed from a number of light-emitting surface elements which are arranged fixed in a three-dimensional structure.

42. The arrangement for 3D recording of at least one object surface (5) in at least one scene as claimed in ~~at least one of claims 39~~ claim 39 or 40, characterized in that the structured array is a transparent microlens array, and the focal length and the axial position of the microlenses are designed such that their foci are arranged in a 3D surface which at least approximately represents a surface which is optically conjugated with respect to the nominal surface, and the foci of the microlenses at least approximately represent optically conjugated locations of the nominal surface of an item

being tested.

43. The arrangement for 3D recording of at least one object surface (5) in at least one scene as claimed in ~~at least one of claims 39 to 41~~ Claim 39 characterized in that at least one relief with a three-dimensional structure having at least one period in the form of at least one ramp (54, 56) with at least one ramp surface (55, 57) which is oblique in the regression surface is formed on the structured array (53), and light-emitting surface elements on the inclined ramp surface (55, 57) are arranged as window surfaces which are illuminated by the radiation source (4), and the ramp surfaces (55, 57) are inclined such that the regression line (AG_{Aj}) through the inclined ramp surfaces (55, 57) in the main section after imaging by the illumination objective (1) in the object area produces, as the image, a straight line (AG_{Oj}) which points at least approximately at the pupil center (PZ_{OA}) of the imaging objective (2), with a group of straight lines (B_1) with the convergence point (K_1) being formed for a number of different regression lines (AG_{Oj}) from a number of different ramps (54, 56), from their images, after they have been imaged by the illumination objective (1), and the convergence point (K_1) being made to coincide at least approximately with the pupil center (PZ_{OA}) of the imaging objective (2).

44. The arrangement for 3D recording of at least one object surface (5) in at least one scene as claimed in claim 43, characterized in that the light-emitting surface elements are arranged as a binary coding pattern.

45. The arrangement for 3D recording of at least one object surface (5) in at least one scene having two imaging beam paths by means of two imaging objectives (2, 33), which are at least approximately physically identical and are arranged parallel, a first imaging objective (2) and a

second imaging objective (33), with the main planes of the two imaging objectives (2, 33) being made to coincide and each of them being associated with a respective receiver array, so that a first and second receiver array are arranged, characterized in that the first and the second receiver array each have at least one associated movement system, and the resultant movement of the first receiver array takes place on a path on a first upper branch of a letter Y, and the path lies parallel to a straight line (g_{A1P}) which, firstly, intersects the focal point of the first imaging objective (2) in the array area and, secondly, intersects the point (P_A) at which the axis of symmetry passes through the coincident main planes between the two optical axes of the two imaging objectives (2, 33), with a part of the line of symmetry forming the lower part of the letter Y, and the resultant movement of the second receiver array taking place on a path on the second upper branch of the letter Y, and the path lying parallel to a straight line (g_{A2P}) which, firstly, intersects the focal point of the second imaging objective (33) and, secondly, intersects the point (P_A) at which the line of symmetry passes through the coincident main planes.

46. The arrangement for 3D recording of at least one object surface (5) in at least one scene having two imaging beam paths by means of two imaging objectives (2, 33), which are at least approximately physically identical and are arranged parallel, a first imaging objective (2) and a second imaging objective (33), with the main planes of the two imaging objectives (2, 33) being made to coincide and each of them being associated with a respective receiver array, so that a first and second receiver array are arranged, characterized in that the first and the second receiver array each have at least one associated

movement system, and the resultant movement of the first receiver array takes place on a path parallel to the optical axis of the first imaging objective (2), and the only elements in the first receiver array which are read and are used to form a signal profile of those which are located on paths (AS_{A1j}) which lie parallel to a straight line (g_{A1P}) which, firstly, intersects the focal point of the first imaging objective (2) in the array area and, secondly, intersects the point (P_A) of which the axis of symmetry passes through the coincident main planes between the two optical axes of the two imaging objectives (2, 33), with a part of the line of symmetry forming the lower part of a letter Y, and the resultant movement direction of the second receiver array taking place on a path parallel to the optical axis of the second imaging objective (33), and the only elements of the second receiver array which are read and which are used to form a signal profile being those which are located on paths which lie parallel to a straight line (g_{A2P}) which, firstly, intersects the focal point of the second imaging objective (2) in the array area and, secondly, intersects the point (P_A) at which the axis of symmetry passes through the coincident main planes.

47. The arrangement for 3D recording of at least one object surface (5) in at least one illuminated scene having two imaging beam paths by means of two imaging objectives, which are at least approximately physically identical and are arranged at least approximately parallel, a first imaging objective and a second imaging objective, with the main planes of the two imaging objectives being made to coincide at least approximately, with the pupil center of the first imaging objective being arranged at a distance (d) from the pupil center of the second imaging objective, and each of them having a respective

associated receiver array with detecting elements, so that a first and a second receiver array are arranged, characterized in that the first and the second receiver array are each arranged at least approximately at right angles to the main section, and the receiver surface of the first receiver array is arranged at least approximately such that it includes the path which is arranged on the first upper branch of a letter Y, and the path is arranged at least approximately parallel to a straight line which, firstly, intersects the focal point of the first imaging objective in the array area and, secondly, at least approximately intersects the point at which the line of symmetry passes through the coincident main planes between the two optical axes of the two imaging objectives, with a part of the line of symmetry forming the lower part of the letter Y, and the receiver surface of the second receiver array being arranged at least approximately such that it includes the path which is arranged on the second upper branch of the letter Y, and the path is arranged parallel to a straight line which, firstly, intersects the focal point of the second imaging objective in the array area and, secondly, at least approximately intersects the point at which the line of symmetry passes through the coincident main planes, and thus at least one pair of at least approximately optically conjugated images is formed at least from images of parts of the two receiver surfaces in the object area.

48. The arrangement for 3D recording of at least one object surface (5) in at least one illuminated scene having at least two imaging beam paths by means of two imaging objectives, a first (33) and a second imaging objective (2), with the pupil center of the first imaging objective (33) being arranged at a distance (d) from the pupil

center of the second imaging objective (2) and each of them having a respective associated receiver array, so that a first (106) and a second receiver array (114) are arranged, characterized in that the first and the second receiver array are structured in three dimensions, and each have at least two receiver surfaces on surfaces which are separated in three dimensions, and the receiver surfaces (107, 108) of the first receiver array (106) and the receiver surfaces (109, 110) of the second receiver array are each (114) arranged such that pairs of optically conjugated images of at least parts of receiver surfaces of the first receiver array (106) and of parts of the receiver surfaces of the second receiver array (114) are formed, at least approximately, in the object area.

49. The arrangement for 3D recording of at least one object surface (5) in at least one scene as claimed in ~~at least one of claims 28 to 48,~~ Claim 28 characterized in that the receiver array is a CCD matrix camera (6).

50. The arrangement for 3D recording of at least one object surface (5) in at least one scene as claimed in ~~at least one of claims 28 to 49,~~ Claim 28 characterized in that the receiver array is a CMOS matrix camera.